

Baker (H. B.)

A REPORT
ON THE
DEATH-RATE OF EACH SEX IN MICHIGAN,
AND A
COMPARISON WITH DR. FARR'S LIFE TABLES OF
HEALTHY DISTRICTS OF ENGLAND.

WITH A STATEMENT CONCERNING
INFANT MORTALITY IN MICHIGAN.

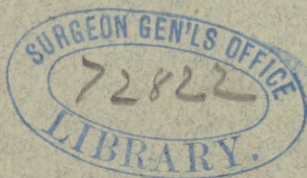
BY

HENRY B. BAKER, M. D.,

SECRETARY OF THE STATE BOARD OF HEALTH, AND REGISTRAR OF VITAL STATISTICS IN MICHIGAN.

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HENRY B. BAKER, M. D.,

LANSING, MICH.

A REPORT ON THE DEATH-RATE OF EACH SEX IN MICHIGAN, AND A COMPARISON WITH DR. FARR'S LIFE TABLES OF HEALTHY DISTRICTS OF ENGLAND.

By HENRY B. BAKER, M. D.,

Secretary of the State Board of Health, and Registrar of Vital Statistics of Michigan.

READ AT THE ANNUAL MEETING IN PHILADELPHIA, NOVEMBER 10, 1874.

IN stating and comparing the total death-rate in Michigan, I do so by means of Life Tables, for the reason that I know of no other method whereby it can be properly stated or compared. We may say that the annual mortality is such a specified per cent. of the living inhabitants; but the population of our cities and States is far from a fixed one, and varies in each city, State, or country, and the death-rate depends so much upon the age and sex of the inhabitants that no very useful estimate of the healthfulness or unhealthfulness of a climate or locality can be formed from such imperfect data. It is requisite, first, to construct a Life Table, or to reduce the statement to one concerning a "fixed population," — that is, a population such as would be maintained in that locality by a specified, constant, and uniform birth-rate alone, without immigration or emigration.

Life Tables for the entire United States, constructed from the United States censuses, are almost necessarily to some extent "evolved from the inner consciousness" of those who construct them. This is so for the reason that it has not been possible to obtain reliable data which would enable one to make the necessary corrections for the omission of deaths in the enumeration. That this may not stand simply as an unsupported assertion, I wish to cite a few of the recognized authorities. Referring to this subject, the author of the Life Table in the United States Census volume for 1860 remarks: "Hence to know the true law of mortality, we must either await such progressive registration, or else resort to new methods of analysis and combination of the existing statistics, as here proposed." For the Life Table published in that volume the death-rate appears to have been established by first increasing the deaths returned by a constant factor, derived from the mind of the statistician, then separately modifying the death-rate of those aged under five years, of those aged 70 to 80 years, and of those aged 80 to 90 years, each by a different factor arrived at by estimates, apparently based upon the author's general knowledge of vital statistics.

For the Life Table published with the census of 1870, Mr. Elliott increased the deaths returned by 41 per cent., this being requisite to make the death-rate equal that in England and Wales. It may be objected that when this is done we do not learn anything concerning the real death-rate in the United States, for we have forced it to appear the same as already found to

be in some other country. Life Tables thus constructed must necessarily be very much like Life Tables in England and Wales. On this point Mr. Elliott remarks¹ that "It is impossible to determine with precision the amount of deficiency in the return of deaths, but from the results herein computed on the assumption of a deficiency of forty-one per cent., it is easy to calculate corresponding values which shall conform to the assumption of any other supposed rate of deficiency."

In the Insurance Report of Massachusetts for the year 1868, page 103, Mr. L. W. Meach published a Life Table for males in the United States, "upon the ample basis of thirty years' observations," which probably means that it was formed from the three United States Censuses of 1840, 1850, and 1860; but upon what plan the omissions in returns of deaths were estimated is not stated. Other Life Tables may have been published, but all that have come to the writer's notice have been mainly estimates, in the absence of exact evidence on the subject. General Walker, Superintendent of the Ninth United States Census, remarks that "The dimensions attained by the life insurance interest within the past few years make it peculiarly a matter of regret at the present time that the census should not afford the data for determining with absolute precision and certainty the death-rate of the country, whether in the aggregate, or by classes of the population."²

Inasmuch as no method has yet been found, or at least acted upon, whereby the actual death-rate can be positively ascertained for the United States, or, so far as I know, for any single State, I venture to offer these Life Tables for males and for females in Michigan, as tables based entirely upon evidence of the death-rate in the State, the corrections for omissions in enumerating being made upon a principle which does not appear to have been tried in any other locality. The principle upon which the correction is made may be stated briefly as follows: The number actually omitted because of a delay of a given time, as for instance of one year, is ascertained by comparing the results of two separate enumerations of the deaths in the same locality during the same time, one enumeration being made at one time by one set of officers, the other at a different time by a different set of officers. We thus find the proportion of deaths omitted after the lapse of a given time. It is assumed that the proportional number omitted is in proportion to the length of time which has passed since they occurred, and before their enumeration.

It is not possible to say that even if enumerated in the same months in which the deaths occurred none would be forgotten or overlooked; but for this, no correction has been proposed, and none is here offered. It is not probable that many would be omitted under such circumstances.

It is quite probable that some other modification may hereafter be discovered to be essential to perfect accuracy, but the writer believes that this method will be found to be adequate to the correction of at least the greater part of the error in the returns of deaths made after the close of the year in which the deaths occurred, as is the case at present in Michigan and in the enumeration for the United States Census.

¹ Page 10, Vital Stat. U. S. Census, 1870.

² Foot-note on page 9, Vital Stat. U. S. Census, 1870.

The results of this method of correction, which appear in this table for males and females, are based simply upon the evidence collected in one State, and in one year, — that of 1870. In order to render the evidence more reliable, observations must be extended through a long series of years. The death-rate in Michigan, so far as evidenced by the returns, was larger during the year 1870 than it usually is, the increased number of deaths being returned as caused by zymotic diseases. There were no very serious epidemics of small-pox, cholera, or other contagious diseases, except scarlatina, from which 852 deaths were returned. These tables do not therefore include those chances of death attendant upon serious epidemics.

The correction for omissions was made by comparing the returns for the census year as made by the registration officers with those of the census marshals, thus :

Deaths by Census.		Deaths by Registration.	
Dec. 1869.	Jan. 1870.	Dec. 1869.	Jan. 1870.

801 : 800 :: 836 : \times , whence $\times = 834$. The number actually returned for January, 1870, by the registration officers was 421 ; $834 - 421 = 413 = 98.09$ per cent. of the numbers returned. The deaths for December and January were enumerated by the census marshals about five months after they occurred ; the deaths for December were enumerated by the registration officers after about four months, but the deaths for January were not enumerated by the registration officers until after a year and four months. This 98.09 per cent. was therefore added to the deaths for January, 1870, as a correction for omissions because of one year's additional time elapsing between the occurrence of the deaths and their enumeration. Upon evidence which seemed to warrant the assumption, it was assumed that if the lapse of one year's time resulted in omissions to such an extent that 98.09 per cent. of the deaths returned should be added to them to make them equal the deaths which would have been returned if enumerated in months of occurrence, then the lapse of one month's time would require the addition of one twelfth of that per cent. and the intermediate months in a corresponding proportion.

The methods and results of the corrections will be best explained by means of exhibits A and B, and diagrams 3 and 4, graphically representing the same.

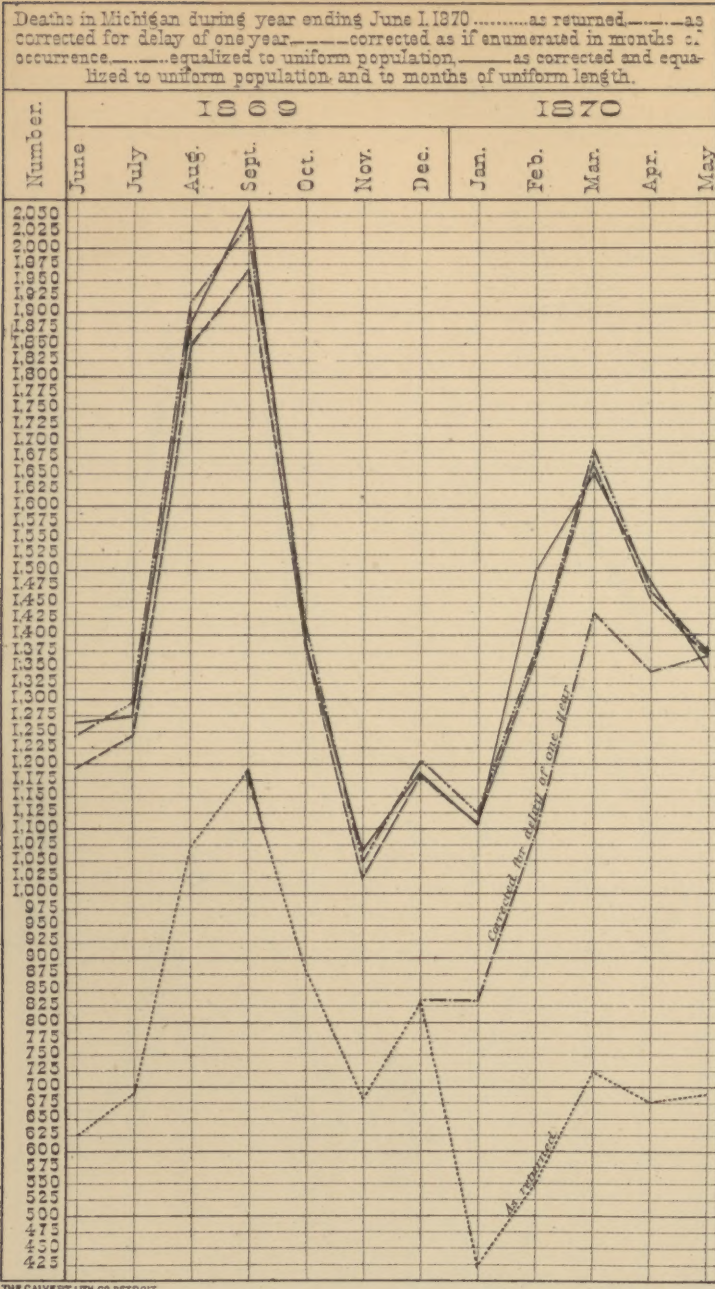
REPORT ON THE DEATH-RATE

EXHIBIT A. — Exhibiting, by Months, and the Total Number for the Census Year ending June 1, 1870, the Deaths as returned by Registration Officers; the Number of Deaths for the Last Five Months of the Census Year, increased by an Estimated Correction for Omissions resulting from One Year Additional Time elapsing before Enumeration, — giving the Number as it would have been if enumerated in May, 1870, instead of May, 1871; the Number of Deaths for the Census Year, increased by an Estimated Correction for Omissions resulting from the Time elapsing before Enumeration, — giving the Number as it would have been if enumerated in Months of Occurrence; the Deaths so corrected, equalized to a Supposed Uniform Population equaling that at close of Year; and the Deaths thus corrected and equalized, equalized to Months of uniform length.

	Total.	1869.						1870.					
		June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May.
Deaths as returned by registration officers	9,040	630	687	1,068	1,104	874	686	836	421	553	724	678	689
Per cent. of deaths to be added for correction for one year additional time before enumeration . . . . .	.....	.....	.....	.....	.....	.....	.....	.....	98.09	98.09	98.09	98.09	98.09
Deaths, if enumerated in May, 1870, instead of May, 1871	6,071	.....	.....	.....	.....	.....	.....	.....	834	1,095	1,434	1,343	1,365
Per cent. of deaths to be added for correction for time before enumeration . . . . .	.....	89.92	81.75	73.58	65.41	57.24	49.07	40.90	32.73	24.56	16.39	8.22	.00
Deaths corrected as if enumerated in months of occurrence	16,802	1,196	1,248	1,853	1,974	1,374	1,022	1,178	1,106	1,364	1,669	1,453	1,365
Deaths as corrected, equalized to population at close of year	17,187	1,246	1,296	1,918	2,036	1,413	1,047	1,203	1,125	1,383	1,687	1,463	1,370
Deaths corrected and equalized to months of uniform length	17,211	1,264	1,273	1,883	2,066	1,388	1,062	1,181	1,105	1,503	1,657	1,484	1,345

The first, third, fifth, sixth, and seventh lines in Exhibit A are graphically represented in Diagram No. 3. The first and last lines of Exhibits A and B are illustrated in Diagram No. 4.

DIAGRAM N^o 3.



THE GALVET LITH. CO. DETROIT.

Designed by H.B. Baker, M.D.

EXHIBIT B. — *By Months, the Number of Deaths in Michigan during the Census Year ending June 1, 1870, as returned by Census Officers; the Number, corrected by calculation, for time elapsing before Enumeration, — giving the calculated Number that would have been returned had they been enumerated in Months of occurrence; the Number Equalized to a supposed constant Population equating the Population at the close of the Year; and the Number of Deaths, thus estimated, equalized to Months of uniform Length of 30.44 days.*

	Total.	1869.						1870.					
		June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April.	May.
Deaths, as returned by census officers, for census year	1 11,160	689	799	1,118	1,097	905	727	801	800	977	1,134	996	1,119
Per cent. of deaths to be added as a correction for time elapsing before enumeration.	.....	98.09	89.92	81.75	73.58	65.41	57.24	49.07	40.90	32.73	24.56	16.39	8.22
Number of deaths to be added for above correction	5,695	674	718	914	807	592	416	393	327	320	279	103	92
Deaths if enumerated in months of occurrence.	16,855	1,361	1,517	2,032	1,904	1,497	1,143	1,194	1,127	1,297	1,413	1,159	1,211
Per cent. of deaths to be added to equalize them to population at close of year	.....	4.21	3.86	3.51	3.16	2.81	2.46	2.11	1.76	1.41	1.06	.71	.35
Deaths to be added to equalize them to population at close of year	2 407	57	59	71	60	42	28	25	20	18	15	8	4
Deaths, as corrected, equalized to population at close of year	17,262	1,418	1,576	2,103	1,964	1,539	1,171	1,219	1,147	1,315	1,428	1,167	1,215
Days and hundredths by which the months should be increased or diminished to equalize them to uniform length	.....	+44	-56	-56	+44	-56	+44	-56	-56	+244	-56	+44	-56
Number by which the deaths should be increased or diminished to equalize them to months of uniform length	+13	+21	-28	-38	+29	-28	+17	-22	-21	+114	-26	+17	-22
Deaths corrected and equalized, equalized to months of uniform length	17,275	1,439	1,548	2,065	1,993	1,511	1,188	1,197	1,126	1,429	1,402	1,184	1,193

¹ Excluding 22 in unknown month.

² Estimated population in 1869 was 1,131,600; in 1870, by same estimate, it was 1,184,672. Assuming the increase of population to have been the same in every month of the year, the average population in which the deaths were collected was 1,158,136. Then $1,158,136 : 1,184,672 :: x$, whence x equals 17,241; $x - 16,835 = 386$, — the number to be added to equalize to population June 1, 1870. The discrepancy between this and the result (407) is due to the fact that in this table the number of deaths in the months opposite which the greatest per cent. is placed chanced to be slightly larger than the average. It is as near as is practicable.

The omissions during the year ending *June 1*, 1870, appeared to be such that the deaths returned should be multiplied by 1.86 in order to equal the number which was believed to have occurred, but the deaths returned for the year ending *December 31*, 1870, corrected upon the same principle, it appears should only be multiplied by 1.79 in order to equal the true number. As the system of registration becomes more perfect, it is probable that the amount of the correction may be modified, and a mean of several years would approximate closer to the true statement. These life tables are made by using the decimal 1.86 with which to multiply the deaths returned, that being the first result of a direct comparison and correction in this manner. It is possible that it may increase the number of deaths slightly more than should be done. For the year for which the tables are made, deaths were also returned in greater number than for the year preceding or succeeding. On the other hand, no very extraordinary epidemic prevailed. The correction is only claimed to make the deaths equal the number which would have been returned if enumerated in the months when they occurred.

In constructing these life tables for Michigan, the population represented by deaths was equalized throughout all ages before computing the death-rate, which was computed for each and every age, in order that if any real "climacteria" exist they might be discovered. Climacteria cannot well be discovered when the death-rate is computed by periods of ten years. If the death-rate is computed by periods of five years, every alternate period will contain the important even year — such as twenty, thirty, forty, fifty, etc. — and the death-rate for that period will appear too small, because the number of inhabitants stated in the census as living at such ages is always too large. The statement of the age of persons who have died is much more accurate than the statement of the age of the living. By equalizing the population *before* computing the death-rate, we may avoid equalizing the deaths, and leave them free to exhibit at each and every age any variation which may occur.

It may be proper in this connection to call attention to the fact that the life table for females in Michigan, does not show any extraordinary increase of the death-rate of women aged forty to fifty years as compared with the males of the same ages; on the contrary for about all ages over that of fifty years, the death-rate of males exceeds that of females. It increases somewhat rapidly, however, for both sexes, at about that age.

The essential columns of these life tables are here presented.

TABLE 1. — Exhibiting the essential parts of Life Tables for each sex in Michigan, stating, for each age, the Chances of Death for one thousand persons living at that age, the Average Future Duration of Life, the Probable Future Duration of Life, and the Probable Age at Death.

Age in Years.	Deaths to one thousand living.		Mean after Lifetime at each Age. ¹		True Expectation of Life (Probable Life).		Probable Age at Death.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
0	160.1	135.0	43.79	44.24	53.05	49.52	53.05	49.52
1	56.2	47.8	51.61	50.07	60.48	58.14	61.48	59.14
2	29.8	23.4	53.65	51.36	61.23	59.93	63.23	61.93
3	22.7	18.8	54.28	51.89	61.24	59.91	64.24	62.91
4	14.0	13.5	54.53	51.87	60.91	59.58	64.91	63.58
5	11.7	11.8	54.30	51.58	60.24	59.03	65.24	64.03
6	8.5	10.7	53.94	51.19	59.48	58.30	65.48	64.30
7	5.9	7.4	53.39	50.73	58.66	57.56	65.66	64.56
8	6.7	6.6	52.71	50.11	57.78	56.73	65.78	64.73
9	5.4	6.6	52.06	49.44	56.92	55.88	65.92	64.88
10	5.6	4.5	51.34	48.76	56.04	55.31	66.04	65.31
11	4.0	4.8	50.63	47.98	55.18	54.17	66.18	65.17
12	5.2	5.3	49.83	47.21	54.29	53.31	66.29	65.31
13	4.0	6.3	49.09	46.46	53.42	52.46	66.42	65.46
14	4.1	5.6	48.28	45.75	52.52	51.65	66.52	65.65
15	3.9	8.8	47.48	45.01	51.63	50.81	66.63	65.81
16	4.2	7.5	46.66	44.40	50.73	50.06	66.73	66.06
17	5.7	9.4	45.86	43.73	49.83	49.29	66.83	66.29
18	4.7	8.7	45.12	43.14	48.98	48.58	66.98	66.58
19	8.8	11.7	44.33	42.52	48.10	47.84	67.10	66.84
20	6.9	8.8	43.72	42.02	47.32	47.16	67.32	67.16
21	10.5	8.4	43.02	41.38	46.49	46.38	67.49	67.38
22	7.3	12.7	42.47	40.73	45.75	45.58	67.75	67.58
23	7.8	8.1	41.78	40.25	44.93	44.89	67.93	67.89
24	6.6	11.2	41.10	39.57	44.20	44.08	68.20	68.08
25	6.1	9.3	40.37	39.02	43.46	43.32	68.46	68.32
26	6.9	10.8	39.62	38.38	42.70	42.52	68.70	68.52
27	6.4	11.1	38.89	37.79	41.97	41.75	68.97	68.75
28	6.7	12.5	38.14	37.21	41.14	40.98	69.14	68.98
29	6.3	8.9	37.39	36.67	40.30	40.29	69.30	69.29
30	5.9	11.4	36.62	36.00	39.45	39.51	69.45	69.51
31	6.3	9.4	35.84	35.41	38.59	38.78	69.59	69.78
32	8.9	18.3	35.06	34.74	37.73	38.00	69.73	70.00
33	7.1	8.4	34.37	34.38	36.94	37.34	69.94	70.34
34	6.2	11.6	33.61	33.66	36.07	36.50	70.07	70.50
35	8.2	15.8	32.82	33.05	35.15	35.70	70.15	70.70
36	6.1	9.1	32.09	32.58	34.27	34.99	70.27	70.99
37	6.3	11.4	31.28	31.87	33.36	34.16	70.36	71.16
38	10.0	13.6	30.48	31.23	32.45	33.38	70.45	71.38
39	6.3	10.5	29.78	30.66	31.59	32.64	70.59	71.64
40	9.2	8.2	28.96	29.98	30.67	31.83	70.67	71.83
41	6.4	8.1	28.23	29.22	29.80	30.99	70.80	71.99
42	9.3	13.7	27.41	28.46	28.89	30.12	70.89	72.12
43	10.8	11.4	26.66	27.84	28.01	29.35	71.01	72.35
44	11.5	10.4	25.95	27.16	27.18	28.53	71.18	72.53
45	11.0	11.2	25.24	26.44	26.36	27.70	71.36	72.70
46	11.0	6.3	24.52	25.73	25.53	26.88	71.53	72.88
47	8.5	11.5	23.78	24.89	24.70	25.98	71.70	72.98
48	10.3	14.7	22.98	24.18	23.82	25.15	71.82	73.15
49	12.6	11.5	22.22	23.53	22.98	24.36	71.98	73.36
50	17.5	16.6	21.50	22.80	22.13	23.53	72.13	73.53
51	12.4	9.1	20.87	22.17	21.33	22.76	72.33	73.76
52	18.5	14.5	20.12	21.37	20.47	21.89	72.47	73.89
53	15.3	14.8	19.49	20.68	19.68	21.08	72.68	74.08

¹ Average Future Duration of Life, so-called "Expectation of Life."

TABLE I. — *Life Table for Michigan, Continued.*

Age in Years.	Deaths to one thousand living.		Mean after Lifetime at each Age. ¹		True Expectation of Life (Probable Life).		Probable Age at Death.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
54	17.8	13.2	18.79	19.98	18.85	20.26	72.85	74.26
55	22.1	17.2	18.12	19.24	18.06	19.42	73.06	74.42
56	19.5	20.5	17.52	18.57	17.37	18.62	73.37	74.62
57	29.2	18.0	16.86	17.95	16.64	17.85	73.64	74.85
58	25.0	12.3	16.35	17.27	16.04	17.07	74.04	75.07
59	19.2	15.0	15.76	16.48	15.39	16.22	74.39	75.22
60	24.2	20.1	15.06	15.72	14.65	15.41	74.65	75.41
61	24.3	16.7	14.42	15.04	13.97	14.67	74.97	75.67
62	37.9	26.6	13.76	14.28	13.28	13.87	75.28	75.87
63	28.3	28.4	13.29	13.66	12.74	13.15	75.74	76.15
64	33.3	42.5	12.66	13.04	12.07	12.42	76.07	76.42
65	47.0	34.0	12.08	12.60	11.39	11.80	76.39	76.80
66	38.3	32.7	11.65	12.03	10.84	11.12	76.84	77.12
67	39.6	40.1	11.09	11.42	10.18	10.46	77.18	77.46
68	24.9	45.9	10.53	10.87	9.51	9.86	77.51	77.86
69	41.7	40.6	9.79	10.37	8.71	9.26	77.71	78.26
70	69.3	54.0	9.19	9.79	8.04	8.59	78.04	78.59
71	63.8	51.7	8.84	9.32	7.70	8.00	78.70	79.00
72	85.3	60.3	8.41	8.80	7.25	7.44	79.25	79.44
73	70.1	67.9	8.15	8.33	6.92	6.92	79.92	79.92
74	71.8	82.3	7.72	7.90	6.48	6.47	80.48	80.47
75	79.7	77.5	7.28	7.57	6.02	6.11	81.02	81.11
76	101.0	105.1	6.87	7.16	5.63	5.71	81.63	81.71
77	117.4	96.0	6.58	6.94	5.36	5.51	82.36	82.51
78	105.3	120.7	6.40	6.63	5.16	5.20	83.16	83.20
79	122.6	118.3	6.09	6.47	4.87	5.06	83.87	84.06
80	126.0	123.1	5.87	6.27	4.66	4.89	84.66	84.89
81	129.4	127.9	5.65	6.08	4.44	4.72	85.44	85.72
82	142.8	132.7	5.41	5.89	4.23	4.57	86.23	86.57
83	145.2	137.5	5.23	5.72	4.09	4.42	87.09	87.42
84	157.0	142.3	5.04	5.55	3.93	4.26	87.93	88.26
85	159.1	147.1	4.88	5.39	3.80	4.13	88.80	89.13
86	161.2	151.9	4.71	5.24	3.64	4.00	89.64	90.00
87	171.0	156.7	4.52	5.09	3.46	3.89	90.46	90.87
88	180.8	161.5	4.35	4.94	3.30	3.77	91.30	91.77
89	190.6	166.3	4.21	4.79	3.16	3.65	92.16	92.65
90	197.1	171.6	4.08	4.65	3.05	3.54	93.05	93.54
91	203.5	177.5	3.96	4.51	2.95	3.42	93.95	94.42
92	210.0	183.4	3.85	4.37	2.86	3.31	94.86	95.31
93	216.5	189.3	3.74	4.24	2.78	3.20	95.78	96.20
94	223.0	195.2	3.63	4.12	2.70	3.09	96.70	97.09
95	229.5	201.1	3.53	3.99	2.63	2.99	97.63	97.99
96	235.9	207.0	3.43	3.87	2.55	2.91	98.55	98.91
97	242.4	212.9	3.34	3.75	2.48	2.84	99.48	99.84
98	248.9	218.8	3.25	3.63	2.40	2.76	100.40	100.76
99	255.4	224.7	3.17	3.50	2.34	2.68	101.34	101.68
100	261.9	230.6	3.09	3.37	2.29	2.61	102.29	102.61
101	268.3	236.5	3.00	3.23	2.23	2.54	103.23	103.54
102	274.8	242.4	2.91	3.08	2.20	2.49	104.49	104.49
103	281.3	248.3	2.81	2.90	2.07	2.43	105.07	105.43
104	287.8	254.2	2.70	2.69	2.00	2.38	106.00	106.38
105	294.3	260.1	2.62	2.43	2.00	2.33	107.00	107.33
106	300.7	266.0	2.50	2.11	2.00	2.16	108.00	108.16
107	307.2	271.9	2.33	1.67	2.00	1.61	109.00	108.61
108	313.7	514.6	2.08	1.09	2.00	.95	110.00	108.95
109	320.2	757.3	1.75	.75	1.67	.67	110.67	109.67
110	326.7	1000.0	1.37	.50	1.33	.50	111.33	110.50
111	663.3	—	.90	—	1.00	—	112.00	—
112	1000.0	—	.50	—	.50	—	112.50	—

¹ Average Future Duration of Life, so-called "Expectation of Life."

TABLE 2. — *Exhibiting the essential parts of Life Tables, for each Sex, in the Healthy Districts of England, stating the Chances of Death for one thousand persons living at each age, the Average Future Duration of Life at every fifth age, the Probable Future Duration of Life at each age, and the Probable Age at Death.*

Age in Years.	Deaths to one thousand living ¹		Mean after Lifetime at each age. ²		True Expectation of Life (Probable Life). ¹		Probable Age at Death. ¹	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
0	112.8	92.6	48.56	49.45	58.55	59.24	58.55	59.24
1	55.1	31.9	—	—	62.32	62.26	63.32	63.26
2	21.8	21.7	—	—	62.41	62.34	64.41	64.34
3	15.4	15.3	—	—	62.04	62.02	65.04	65.04
4	12.6	12.5	—	—	61.46	61.48	65.46	65.48
5	10.3	10.3	54.39	53.93	60.80	60.84	65.80	65.84
6	8.3	8.4	—	—	60.06	60.13	66.06	66.13
7	6.7	7.0	—	—	59.24	59.36	66.24	66.36
8	5.5	5.9	—	—	58.39	58.55	66.39	66.55
9	4.6	5.2	—	—	57.51	57.71	66.51	66.71
10	4.0	4.7	51.28	50.88	56.61	56.84	66.61	66.84
11	3.6	4.5	—	—	55.70	55.97	66.70	66.97
12	3.6	4.5	—	—	54.78	55.08	66.78	67.08
13	3.6	4.7	—	—	53.86	54.20	66.86	67.20
14	3.9	5.1	—	—	53.05	53.32	67.05	67.32
15	4.3	5.5	47.20	47.04	52.13	52.44	67.13	67.44
16	4.7	6.0	—	—	51.23	51.55	67.23	67.58
17	5.2	6.5	—	—	50.34	50.72	67.34	67.72
18	5.8	6.9	—	—	49.46	49.88	67.46	67.88
19	6.4	7.4	—	—	48.59	49.05	67.59	68.05
20	7.0	7.7	43.40	43.50	47.74	48.22	67.74	68.22
21	7.1	7.9	—	—	46.89	47.40	67.89	68.40
22	7.3	8.0	—	—	46.05	46.57	68.05	68.57
23	7.5	8.1	—	—	45.20	45.76	68.20	68.76
24	7.6	8.3	—	—	44.36	44.94	68.36	68.94
25	7.8	8.4	39.93	40.18	43.52	44.12	68.52	69.12
26	7.8	8.5	—	—	42.68	43.30	68.68	69.30
27	7.9	8.6	—	—	41.84	42.48	68.84	69.48
28	8.0	8.8	—	—	41.00	41.66	69.00	69.66
29	8.1	8.8	—	—	40.16	40.84	69.16	69.84
30	8.2	8.9	36.45	36.85	39.31	40.02	69.31	70.02
31	8.3	9.0	—	—	38.47	39.20	69.47	70.20
32	8.3	9.1	—	—	37.63	38.37	69.63	70.37
33	8.4	9.2	—	—	36.79	37.55	69.79	70.55
34	8.5	9.3	—	—	35.94	36.73	69.94	70.73
35	8.7	9.4	32.90	33.46	35.10	35.90	70.10	70.90
36	8.8	9.5	—	—	34.25	35.08	70.25	71.08
37	8.9	9.7	—	—	33.41	34.25	70.41	71.25
38	9.0	9.8	—	—	32.57	33.42	70.57	71.42
39	9.2	9.9	—	—	31.72	32.59	70.72	71.59
40	9.6	10.0	29.29	30.00	31.19	31.77	71.19	71.77
41	9.6	10.2	—	—	30.04	30.94	71.04	71.94
42	9.8	10.3	—	—	29.20	30.11	71.20	72.11
43	10.1	10.5	—	—	28.36	29.28	71.36	72.28
44	10.4	10.7	—	—	27.52	28.45	71.52	72.45
45	10.8	10.9	25.65	26.46	26.69	27.63	71.69	72.63
46	11.1	11.1	—	—	25.86	26.80	71.86	72.80
47	11.5	11.4	—	—	25.03	25.98	72.03	72.98
48	12.0	11.6	—	—	24.21	25.15	72.21	73.15
49	12.5	11.9	—	—	23.39	24.33	72.39	73.33

¹ Computed from Dr. Farr's Life Tables.

² Average Future Duration of Life, so-called "Expectation of Life." Taken from Dr. Farr's *Life Tables for Healthy Districts*. Quoted from Walford's *Insurance Cyclopædia*.

TABLE 2. — *For Healthy Districts of England, Continued.*

Age in Years.	Deaths to one thousand living. ¹		Mean after Lifetime at each age. ²		True Expectation of Life (Probable Life). ¹		Probable Age at Death. ¹	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
50	13.0	12.2	22.03	22.87	22.58	23.51	72.58	73.51
51	13.6	12.5	—	—	21.77	22.69	72.77	73.69
52	14.2	12.9	—	—	20.96	21.87	72.96	73.87
53	14.9	13.3	—	—	20.16	21.06	73.16	74.06
54	15.7	13.7	—	—	19.37	20.24	73.37	74.24
55	16.5	14.1	18.45	19.24	18.59	19.43	73.59	74.43
56	17.4	14.2	—	—	17.81	18.63	73.81	74.63
57	18.3	16.2	—	—	17.04	17.82	74.04	74.82
58	19.4	18.2	—	—	16.28	17.04	74.28	75.04
59	21.4	20.3	—	—	15.52	16.27	74.52	75.27
60	23.7	22.3	15.06	15.69	14.79	15.53	74.79	75.53
61	26.1	24.4	—	—	14.07	14.81	75.07	75.81
62	28.5	26.5	—	—	13.38	14.10	75.38	76.10
63	31.1	28.8	—	—	12.71	13.42	75.71	76.42
64	33.9	31.2	—	—	12.06	12.75	76.06	76.75
65	36.8	33.9	12.00	12.58	11.43	12.10	76.43	77.10
66	44.8	36.7	—	—	10.82	11.47	76.82	77.47
67	43.4	39.7	—	—	10.23	10.85	77.23	77.85
68	47.2	43.1	—	—	9.66	10.26	77.66	78.26
69	51.2	46.8	—	—	9.11	9.68	78.11	78.68
70	55.6	50.8	9.37	9.85	8.58	9.12	78.58	79.12
71	60.4	55.2	—	—	8.07	8.59	79.07	79.59
72	65.7	60.0	—	—	7.59	8.08	79.59	80.08
73	71.3	65.2	—	—	7.13	7.59	80.13	80.59
74	77.4	71.0	—	—	6.69	7.12	80.69	81.12
75	84.0	77.2	7.15	7.52	6.27	6.67	81.27	81.67
76	91.1	83.9	—	—	5.87	6.25	81.87	82.25
77	98.6	91.1	—	—	5.50	5.84	82.50	82.84
78	106.9	99.0	—	—	5.14	5.47	83.14	83.47
79	115.5	107.3	—	—	4.81	5.10	83.81	84.10
80	124.9	116.2	5.37	5.64	4.50	4.77	84.50	84.77
81	134.7	125.8	—	—	4.20	4.46	85.20	85.46
82	145.2	135.9	—	—	3.93	4.16	85.93	86.16
83	156.4	146.9	—	—	3.68	3.88	86.68	86.88
84	167.9	158.1	—	—	3.44	3.63	87.44	87.63
85	180.2	173.0	4.01	4.19	3.21	3.39	88.21	88.39
86	193.4	182.9	—	—	2.99	3.16	88.99	89.16
87	206.5	196.5	—	—	2.81	2.95	89.81	89.95
88	220.8	210.0	—	—	2.64	2.77	90.64	90.77
89	235.6	224.5	—	—	2.48	2.59	91.48	91.59
90	250.7	240.3	2.99	3.11	2.32	2.43	92.32	92.43
91	265.6	254.8	—	—	2.17	2.27	93.17	93.27
92	281.9	272.1	—	—	2.01	2.12	94.01	94.12
93	301.2	287.7	—	—	1.90	1.97	94.90	94.97
94	314.5	307.7	—	—	1.81	1.86	95.81	95.86
95	335.1	321.4	2.25	2.32	1.71	1.76	96.71	96.76
96	348.8	345.0	—	—	1.63	1.66	97.63	97.66
97	369.0	357.1	—	—	1.52	1.59	98.52	98.59
98	396.2	375.0	—	—	1.42	1.50	99.42	99.50
99	406.2	400.0	—	—	1.38	1.41	100.38	100.41
100	421.1	407.4	1.69	1.75	1.30	1.36	101.30	101.36
101	454.5	437.5	—	—	1.17	1.25	102.17	102.25
102	500.0	444.4	—	—	1.00	1.17	103.00	103.17
103	333.3	600.0	—	—	1.50	.83	104.50	103.83
104	500.0	500.0	—	—	1.00	1.00	105.00	105.00
105	1000.0	—	—	—	.50	1.50	105.50	106.50
106	—	1000.0	—	—	—	.50	—	106.50

¹ Computed from Dr. Farr's Life Tables.² Average Future Duration of Life, so-called "Expectation of Life." Taken from Dr. Farr's *Life Tables for Healthy Districts*. Quoted from Walford's *Insurance Cyclopædia*.

After making the most that could conveniently be made of the evidence to be obtained in Michigan, it became desirable to bring external evidence to bear upon the result. In looking about for some proper standard of comparison, the Life Tables constructed by Dr. Farr for the "healthy districts" of England have been selected, for several reasons: the two localities are not very dissimilar as regards average temperature, moisture of the atmosphere, etc.; both are nearly surrounded by water, the inhabitants of the two localities number about the same, and although there are many points of contrast, these "healthy districts" of England bear quite a close relation to Michigan as regards conditions affecting life and health. Finally, it is about the only locality of which I have seen Life Tables which seem worthy of confidence as approximate statements. Life Tables of insured persons can be more easily secured; but comparisons therewith cannot be undertaken here, however interesting they may prove to be.

As regards the selection of these "Healthy Districts of England," Dr. Farr says:—

"We have no means of ascertaining what the rate of mortality would be among men living in the most favorable sanitary conditions: otherwise observations for a term of years on a considerable number of such persons would supply a standard rate with which other rates could be compared. In the absence of such a standard, the districts of England in which the mortality rate did not exceed 17 annual deaths in 1,000 living have been selected as the basis of a new Life Table.¹

"For the sake of convenience, these were called 'healthy districts,' consisting of sixty-four, or nearly a tenth part of the total registered districts of England and Wales, and inhabited by nearly a million of people. Sixty-three of these districts have been taken as the basis of the new Life Table."²

It is not claimed that we have gained a knowledge of the rate of mortality among persons living under the most favorable sanitary conditions. On this point Dr. Simon, in the First Report to the Privy Council, said: "In conclusion, I beg to observe that even in the very districts to which, provisionally, I refer as standards of health, there are deaths of a preventable kind; not many, indeed, but enough to satisfy your lordships that the healthiness of those districts, as compared with perfection, is but of moderate excellence; and enough to show that, if in those districts the population had exhausted all known means for removing the causes of disease, their death-rate would have contrasted still more strikingly with that of the unhealthier districts."³

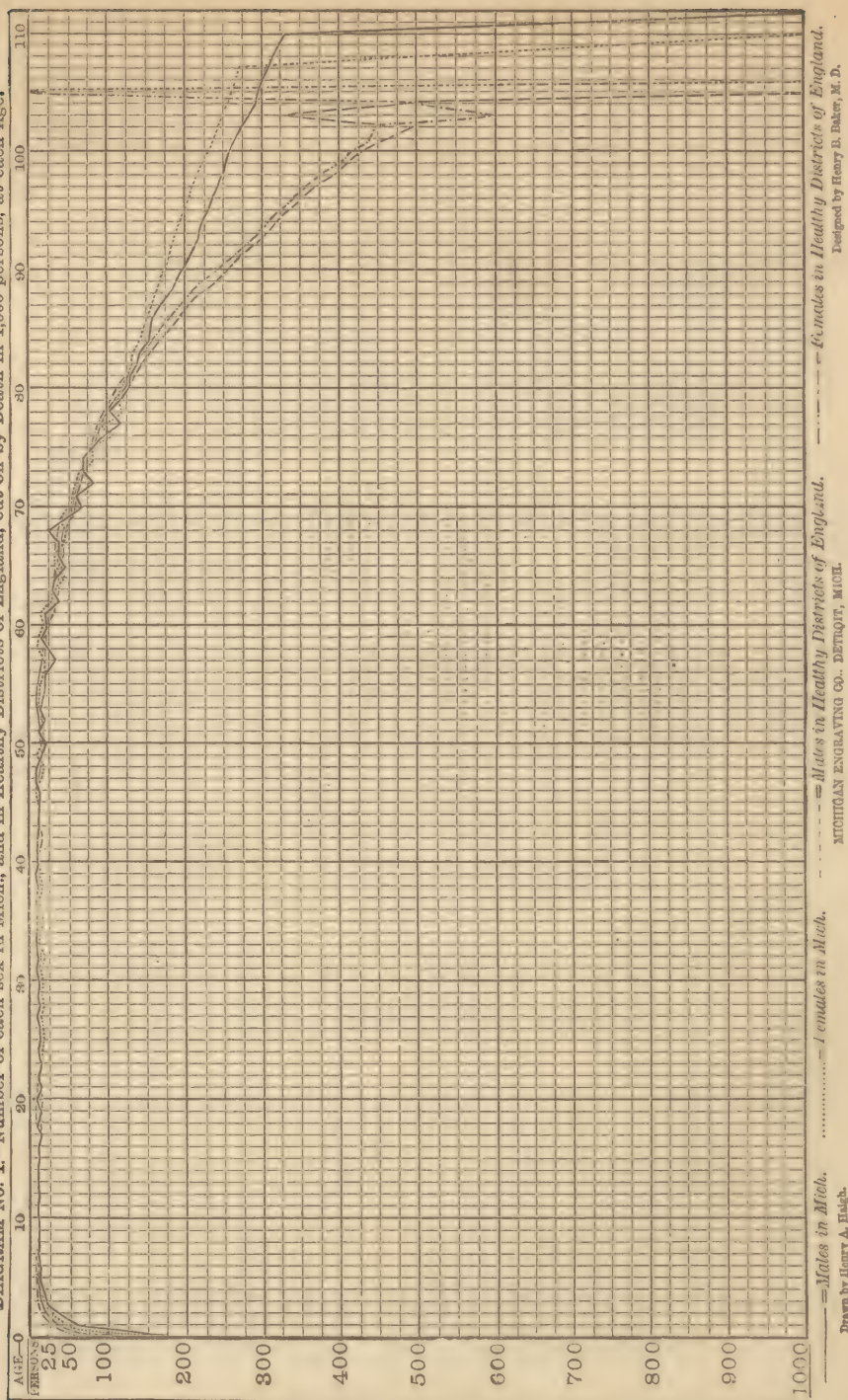
The results of a comparison of the two Life Tables are best shown by means of diagrams. Diagram No. 1 exhibits, by numbers down from the top, and stated at left side, the deaths in 1,000 persons of each sex, at each age, in Michigan, and in the "healthy districts" of England. It will be seen that the several lines representing these four classes of persons bear a very

¹ William Farr, M. D., F. R. S., *Annual Report of Registrar General*, 1859, p. 174. Walford's *Insurance Cyclopædia*, vol. ii., p. 538.

² Dr. Farr, *Philosophical Transactions for 1860*; *Assurance Magazine*, vol. ix., p. 121; Walford's *Insurance Cyclopædia*, vol. ii., p. 539.

³ Dr. Simon, in *First Report to the Privy Council*, 1859; Walford's *Cyclopædia of Insurance*, p. 540.

DIAGRAM NO. 1.—Number of each sex in Mich., and in Healthy Districts of England, cut off by Death in 1,000 persons, at each Age.

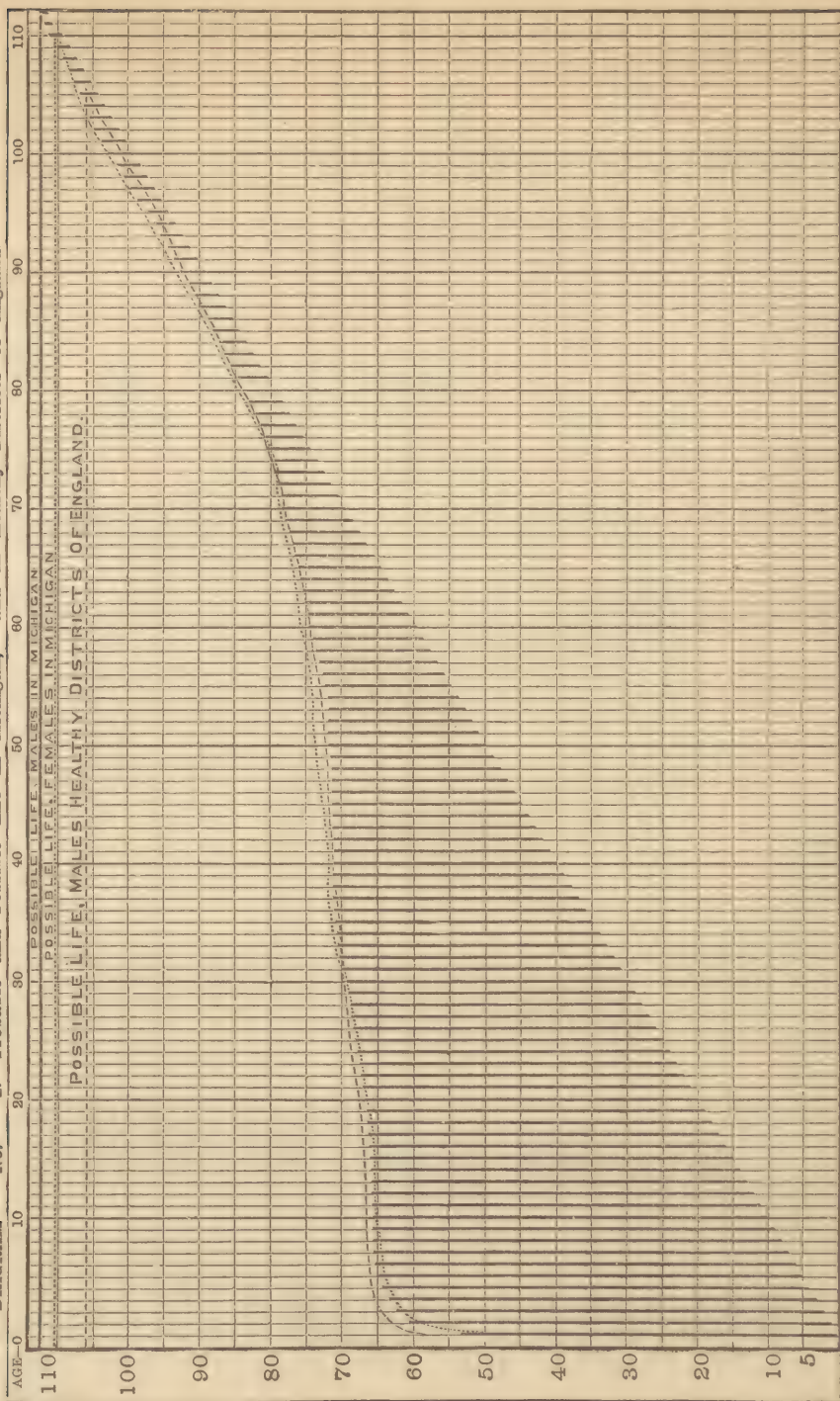


close resemblance at all ages until that of eighty years is reached, when the lines for England fall below those for Michigan, indicating, according to the data used, a higher death-rate at the older ages in England than in Michigan. The slightly greater death-rate in Michigan of those under one year of age may be explained by the fact that in Michigan still-births are included, but this will not explain the slightly greater death-rate at other ages under five years.

Diagram No. 2 exhibits graphically the probable duration of life of males in Michigan; and, by means of lines marking the upper limit of the probable life of females in Michigan and of males in the "healthy districts" of England, the close correspondence therewith is rendered apparent. At the top of the diagram is also exhibited the limit of "Possible Life." The heavy straight line at the top of the diagram is the limit of possible life of males in Michigan, — at the age of 112 years. The dotted straight line near the top of the diagram is the limit of possible life of females in Michigan, — 110 years. The dashed straight line near the top of the diagram is the limit of the possible life of males in the "healthy districts" of England, — 105 years. A corresponding line showing the limit of possible life for females is not drawn, as it would fall so near the line for males as not to be noticeable, — 106 years. The heavy vertical lines represent the probable life of males in Michigan. The bottoms of these lines begin at each succeeding age, from birth to 112 years. The tops of the lines are opposite the probable age at death, shown in the column on the left. As the diagram is drawn to scale, the probable duration of life is shown for each age by the length of the heavy vertical line. The dotted line, running near the tops of the vertical lines, represents the limit of probable life for females in Michigan, and the line of dashes shows the limit of probable life of males in the "healthy districts" of England. The corresponding line for females runs so near to this that it cannot well be drawn. The starting-point for each sex in each country is the same as for the males in Michigan; namely, opposite each particular year of age, shown on the left of the diagram for every decennial year.

One of the objects in view in preparing Diagram No. 2 was to enable those who examine it most easily to appreciate the very great difference between the "Probable Life" and the "Possible Life" at each and every age. This diagram relates to the "Healthy Districts" of England and to the healthful State of Michigan, and it will be seen by the line referring to Michigan, in this diagram, that except for the ages between one and twenty-five years, man does not live out one half of his "possible" time; and of the males in England only those aged under thirty-six years live out one half their "possible time." The total death-rate appears to be about the same in the two localities. The difference in this statement in the ages, — twenty-five in Michigan and thirty-six years in England, is caused by the shorter possible time in England, the time of which is stated as 105, whereas in Michigan it is believed to be not less than 112 years.

DIAGRAM No. 2.— Probable and Possible Life in Michigan, and in Healthy Districts of England.



The heavy vertical lines represent probable life of males, and dotted line near their tops marks the limit of probable life of females in Michigan. The dashed line shows same for males in Healthy District of England.

Drawn by Henry A. Ralph.

Michigan Engraving Co., Detroit, Mich.

Designed by Henry D. Baker, M. D.

INFANT MORTALITY IN THE STATE OF MICHIGAN.

BY H. B. BAKER, M. D.

Secretary State Board of Health and Superintendent of Vital Statistics of Michigan.

READ AT THE ANNUAL MEETING IN BALTIMORE, NOVEMBER 11, 1875.

THESE statements are worked out from my "Life Tables" for this State, and are believed to be as near the truth as it is practicable to attain at this time.¹ Quite different statements would appear if there were an attempt to make them from the per cent. of deaths under five to deaths at all ages. Perhaps this might properly be done if the population of the State was a "fixed" population, such as would be maintained by the birth-rate, and controlled by the death-rate which prevails in this State, but the actual population differs from such a "fixed population" by containing a larger proportion of children under five years of age. In such a "fixed population," as computed from my Life Tables for this State, the proportion of persons living aged under five years, to the total number at all ages, is as follows: males, 9.30; females, 9.56 per cent. By the census of 1874, it appears that in the actual population the proportion is as follows: males, 13.24; females, 14.05 per cent. The per cent. of deaths under five to total deaths is consequently larger than it would be if the population was fixed at that which would be controlled by the death-rate in this State, without modification by immigration or emigration. For the year 1872 the per cent. of deaths of those under one year of age to the total deaths was: males, 25.42; females, 23.17; of deaths of those aged under five years to total deaths it was: males, 42.44; females, 40.30.

"What causes are contributing most to infant mortality? (7)" — So far as relates to causes specified in the returns, they are in the order named, Scarlet Fever, Diarrhœa, Cholera Infantum, Pneumonia, and Dysentery. For the year 1873, the deaths reported from these diseases, of those aged under five years, were for each disease in the order named above: 361, 326, 302, 258, and 252. If the deaths from Diarrhœa, Cholera Infantum, and Dysentery be grouped together, and the deaths from "Bowel Diseases" be added, the aggregate number is indeed large. There is not much difficulty in fixing the actual cause of the excessive mortality from these specified causes among the conditions connected with the hot season of the year. It is also reasonably certain that the mortality from these causes is greater in cities and villages than in rural districts. I have no hesitation in subscribing to the belief that much of this infant mortality could be prevented by thorough and

¹ The questions to which the writer here attempts to reply were submitted to him by the Secretary of the Public Health Association in the following terms:—

"*Infant Mortality.* — What percentage of all infants born alive in your community survive to their first birth-day?" (*Ans.* — I reply that for this State, including still-births, it is: males, 83.09 per cent.; females, 86.50 per cent. Concerning those born alive, I have made no special computation.)

"What per cent. survive to the fifth?" (*Ans.* — Including still-births, 73.32 per cent. of the males, and 77.70 per cent. of the females born survive to their fifth birth-day.)

enlightened action by local boards of health in cities and villages. Much more might be prevented if the parents, in all parts of the State, were well informed as to the *causes* of infant mortality. To collect and disseminate information on such subjects is the function of the State Board of Health. For this work "Vital Statistics" are essential; and although the system of registration and report of vital statistics is somewhat new in this State, much information of great value has already been collected upon this subject; and it is hoped that the time is not far distant when the State Board of Health, already established in this State, can disseminate among the people such information on this subject as will tend to lessen the infant mortality in proportion as its warnings are heeded by the people.

Inflammation of the lungs is one of the prominent causes of infant mortality in this State. As to the actual cause of this disease, if the evidence already collected in the vital statistics of this State shall be verified by further examination, much of the infant mortality from this cause may be prevented by intelligent action of those who may control the condition of the air in dwellings and schools, as regards purity and humidity, but more especially as regards the warmth and humidity of the atmosphere in the sleeping-rooms of the children. The greatest number of deaths from this disease seems to occur in a cold and dry atmosphere.

In my first reply to the question "(7)," the deaths from scarlet fever were stated for the year 1873. From this disease, deaths had previously been reported of those aged under five years as follows: in 1869, 163 deaths; in 1870, 531 deaths; in 1871, 408 deaths; in 1872, 336 deaths. It will be seen that this is one of the important causes of infant mortality in this State. In my opinion a very considerable proportion of the deaths from this cause might be prevented, and will be prevented, as soon as the people will act upon the instructions of the State Board of Health. It will take some time, however, for this influence to permeate the whole people sufficiently to result in uniform, prompt, and efficient action for the accomplishment of this result. My belief in the preventability of much of the mortality from scarlet fever is based in part upon the belief that the disease is less fatal among persons who have passed the age of five or six years. Unfortunately we have not yet such records of cases of the disease in this State as will enable one to verify or disprove this belief. If it is true, then prompt isolation of first cases, and thorough destruction of the contagium, will result in saving the lives of many, by postponing the time when the disease shall be contracted. But whether the mortality is or is not less after the infantile period, many lives may be saved by the means suggested; for to some thus shielded in infancy the contagium may never again come in sufficient force to cause the disease. It seems probable that, even with no systematic effort for that purpose, many persons now pass through life without ever having the disease. It is the solemn duty of local boards of health to largely increase this number. I regard the great slaughter of the innocents in this State, by this disease, as a stinging reproach to the local boards of health for their inefficiency, and a powerful argument for the need of a State Board of Health, charged with the noble duty of educating the people in the way of life.

